Géographie physique et Quaternaire

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Sédimentologie et environnements dans le détroit d'Hudson et la baie d'Ungava : nouveaux indices à partir des données sismiques et biostratigraphiques

Sedimentierungsumwelt und Geschichte der Spät-Quaternär-Ablagerungen in der Hudson-Meerenge und der Ungava-Bucht: Zusätzliche Anhaltspunkte durch seismische und biostratigraphische MeBwerte

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Résumé de l'article

Les recherches menées par bateau à l'échelle régionale sur les sédiments des fonds marins ont augmenté les connaissances sur la sédimentologie et les milieux de sédimentation du Quaternaire supérieur dans la région du détroit d'Hudson et de la baie d'Ungava. Les plus grandes épaisseurs de sédiments (jusqu'à 130 m) se trouvent dans le grand bassin à l'est et dans celui à l'ouest, au nord de Charles Island, du détroit d'Hudson. D'importants dépôts se trouvent aussi dans des bassins au sud-ouest de Charles Island, Ie long du centre sud du détroit et dans la partie sud de la baie d'Ungava. Les dépôts glaciaires sont répandus, mais les sédiments glaciomarins et postglaciaires sont surtout concentrés dans les bassins où les sédiments glaciomarins prédominent. Il y a transition latérale des sédiments glaciomarins aux dépôts glaciaires au centre sud du détroit et en bordure de nombreux autres bassins. La datation par accélérateur de particules des coquilles les plus profondes dans les trois carottes des séquences glaciomarines de la région des baies Wakeham et Héricart, dans le centre sud du détroit d'Hudson, ont livré des âges de 8390 ± 70, 8420 ± 80 et 8520 ± 80 BP. Les séquences sous-jacentes aux intervalles datés peuvent renfermer des sédiments glaciomarins contemporains de ceux de 1000 à 2000 ans plus vieux trouvés sur les rivages de la région de la baie de Déception par Gray, Bruneau et autres.

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DEPOSITIONAL ENVIRONMENTS AND HISTORY OF LATE QUATERNARY SEDIMENTS IN HUDSON STRAIT AND UNGAVA BAY: FURTHER EVIDENCE FROM SEISMIC AND BIOSTRATIGRAPHIC DATA*

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ABSTRACT Regional ship-borne investigations of seafloor sediments provide further information on late Quaternary depositional environments and history in the Hudson Strait-Ungava Bay region. Greatest sediment thicknesses, up to 130 m, occur in the large basin in eastern Hudson Strait and in the western Hudson Strait basin north of Charles Island. Significant deposits are also present in basins southwest of Charles Island, along the south central part of the Strait, and in the southern part of Ungava Bay. Glacial drift deposits are widespread, but glaciomarine and postglacial sediments mainly occur in the basinal areas, with glaciomarine sediments generally predominating. Glaciomarine sediments are laterally transitional to glacial drift in the south central part of the Strait, and at many other basin margins. AMS dating of the deepest shells found within three cores from the glaciomarine sequences in the Wakeham Bay-Baie Héricart region of south central Hudson Strait yielded ages of 8390 ± 70, 8420 ± 80, and 8520 ± 80 BP. Sequences underlying the dated intervals may contain time equivalents of glaciomarine sediments 1000-2000 years older found onshore in the Deception Bay area by Gray, Bruneau, and others.

RÉSUMÉ *Sédimentologie et environnements dans le détroit d'Hudson et la baie d'Ungava: nouveaux indices à partir des données sismiques et biostratigraphiques.* Les recherches menées par bateau à l'échelle régionale sur les sédiments des fonds marins ont augmenté les connaissances sur la sédimentologie et les milieux de sédimentation du Quaternaire supérieur dans la région du détroit d'Hudson et de la baie d'Ungava. Les plus grandes épaisseurs de sédiments (jusqu'à 130 m) se trouvent dans le grand bassin à l'est et dans celui à l'ouest, au nord de Charles Island, du détroit d'Hudson. D'importants dépôts se trouvent aussi dans des bassins au sud-ouest de Charles Island, le long du centre sud du détroit et dans la partie sud de la baie d'Ungava. Les dépôts glaciaires sont répandus, mais les sédiments glaciomarins et postglaciaires sont surtout concentrés dans les bassins où les sédiments glaciomarins prédominent. Il y a transition latérale des sédiments glaciomarins aux dépôts glaciaires au centre sud du détroit et en bordure de nombreux autres bassins. La datation par accélérateur de particules des coquilles les plus profondes dans les trois carottes des séquences glaciomarines de la région des baies Wakeham et Héricart, dans le centre sud du détroit d'Hudson, ont livré des âges de 8390 ± 70, 8420 ± 80 et 8520 ± 80 BP. Les séquences sous-jacentes aux intervalles datés peuvent renfermer des sédiments glaciomarins contemporains de ceux de 1000 à 2000 ans plus vieux trouvés sur les rivages de la région de la baie de Déception par Gray, Bruneau et autres.

ZUSAMMENFASSUNG *Sedimentierungsumwelt und Geschichte der Spät-Quaternär-Ablagerungen in der Hudson-Meerenge und der Ungava-Bucht: Zusätzliche Anhaltspunkte durch seismische und biostratigraphische Meßwerte.* Regionale, mit dem Schiff durch-geführte Erforschungen der Meeresgrundsedimente führen zu zusätzlichen Informationen über Sedimentierungsumwelt und geschichte im späten Quaternär im Gebiet der Hudson-Meerenge und der Ungava-Bucht. Die Sedimente erreichen die größte Dicke, bis zu 130 m, im breiten Becken der östlichen Hudson-Meerenge und in dem westlichen Hudson-Meerengebecken nördlich der Insel Charles. Signifikante Ablagerungen finden sich auch in den südwestlich von der Insel Charles gelegenen Becken, entlang dem südlichen Zentrum der Meerenge und im südlichen Teil der Ungava-Bucht. Die Gletscherschutt-Ablagerungen sind weitgedehnt, jedoch kommen glazialmarine und postglaziale Sedimente vor allem in den Becken-Gebieten vor, wobei glazialmarine Sedimente im allgemeinen dominieren. Glazialmarine Sedimente gehen seitlich über in die Gletscherschutt-Ablagerungen im südlichen Zentrum der Meerenge und an vielen anderen Beckenrändern. Die AMS-Datierung der am tiefsten gelegenen Muscheln, die in drei Bohrkernen der glazialmarinen Sequenzen im Wakeham Bay-Baie Hericart-Gebiet vom südlichen Zentrum der Hudson-Meerenge gefunden wurden, ergaben Alter von 8390 ± 70, 8420 ± 80 und 8520 ± 80 v.u.Z. Unter den datierten Intervallen liegende Sequenzen können zeitliche Gegenstücke zu den 1000-2000 Jahre älteren glazialmarinen Sedimenten enthalten, die am Ufer des Deception-Bay-Gebiets von Gray, Bruneau und anderen gefunden wurden.

* Geological Survey of Canada Contribution No. 52491

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INTRODUCTION

Hudson Strait is considered to have been a major conduit for glacial ice from Hudson Bay together with glacial ice from Ungava Peninsula and from Baffin Island. This region is thought also to have been a major meltwater discharge route (see Andrews *et al.* 1983; Dyke and Prest, 1987 a, b; Andrews, 1989; Vincent, 1989 for a detailed review).

This paper presents results from marine geological surveys of Hudson Strait and Ungava Bay in 1990. These surveys provided information on the distribution of sediments, depositional environments, facies relationships and preliminary chronological data from many areas that previously had not been geologically investigated. In particular, the surveys revealed the presence of significant deposits of glaciomarine sediments that are transitional to glacial drift along the south central part of the Strait. The sequences present in this sector represent important data points for information on the history of deglaciation, depositional environments and paleoceanographic conditions in the offshore region adjacent to central and western Ungava Peninsula. Seismic, biostratigraphic, and preliminary chronological data from these areas are related to the geological and biostratigraphic framework outlined by Vilks *et al.* (1989) from cores obtained in the eastern and western basins of Hudson Strait in 1985.

BATHYMETRY

Hudson Strait is an 800 km long channel that connects Hudson Bay to the Atlantic and separates Baffin Island from northern Québec and Labrador. It is some 90 km in width, increasing to 340 km across Ungava Bay. The generalized bathymetry is illustrated in Figure 1. Depths in excess of 200 m are continuous along the Strait, but greatest depths occur in three half-graben basins: one of these is in the east, north of Ungava Bay and contains depths to 900 m, and two are in the western part of the Strait, north, and west-southwest of Charles Island, each with depths greater than 400 m. These basins are down faulted on the south side and

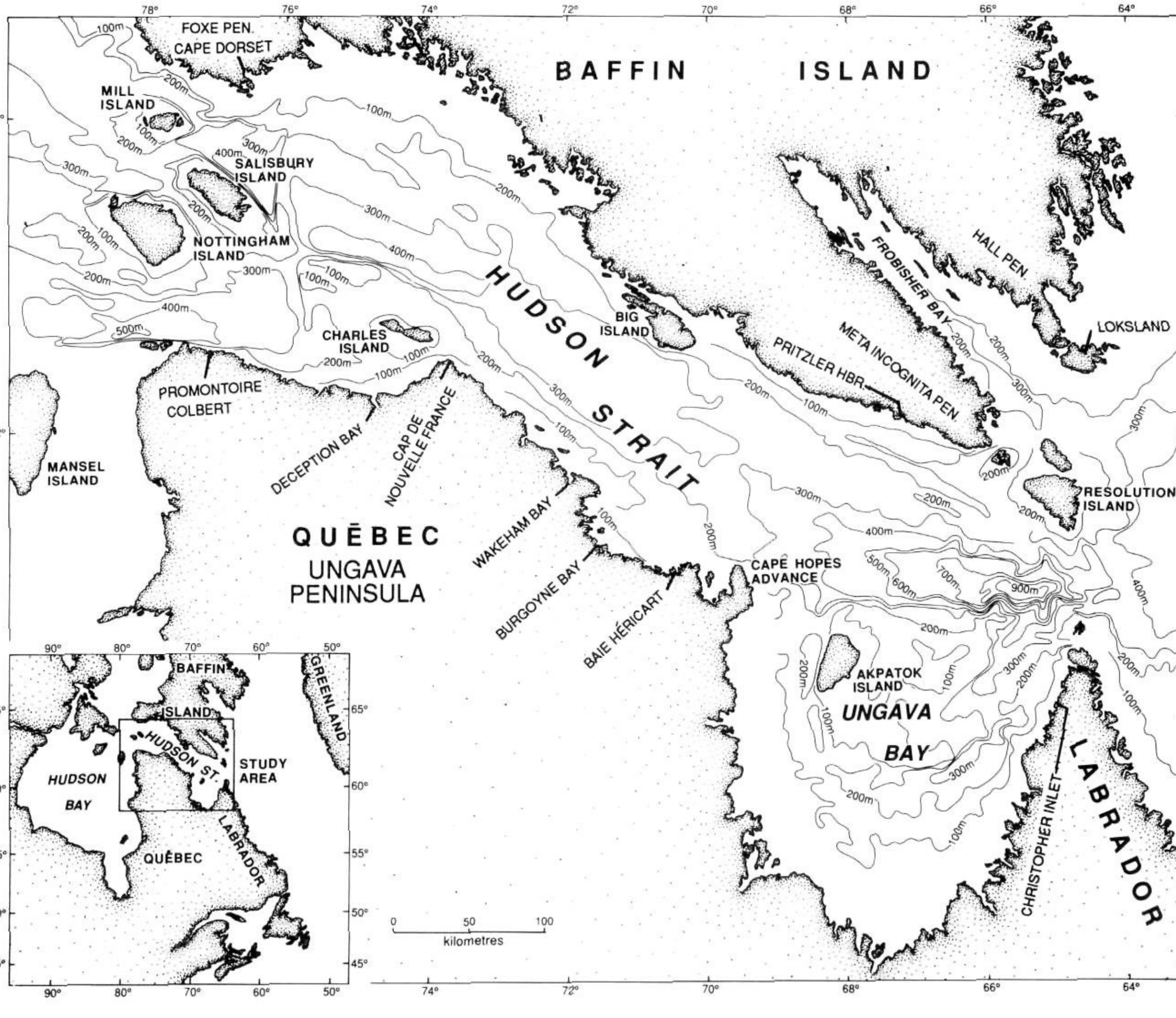


FIGURE 1. Generalized bathymetry of Hudson Strait and Ungava Bay, and index to place names.

Bathymétrie générale et toponymie du détroit d'Hudson et de la baie d'Ungava.

water depths increase progressively from north to south. A narrow sill at a depth of about 400 m separates the deep basin in eastern Hudson Strait from the Labrador Sea. Nottingham, Salisbury, and Mill islands constrict the western end of the Strait.

Ungava Bay is bounded to the north by the fault scarp that forms the southern margin of the Hudson Strait eastern basin. The central part of Ungava Bay is occupied by a shallow platform with depths from 53 to about 135 m. The platform is bounded to the west, south, and east by a marginal channel with maximum depths of 250 m in the west and 365 m in the east.

The present bathymetry reflects the influence of large scale structural control on the underlying bedrock morphology, erosion, and thick deposits of Quaternary sediments, which locally reach 130 m or more. The latter are greatest in the three main basins in Hudson Strait, in bays and fiords along the south side of the Strait, and in the channel marginal to the central plafform in Ungava Bay.

METHODS

Results presented in this paper have been derived from geophysical profile data and samples collected during CSS Hudson cruises 85-027 and 90-023 (Fig. 2). The geophysical data were obtained with a Huntec deep towed high resolution seismic reflection system, hull-mounted 3.5 kHz profiler, single channel seismic reflection system using a 655 cm³ compressed air source and Nova Scotia Research Foundation hydrophone, and Bedford Institute of Oceanography sidescan sonar system. Sediment core samples obtained during Cruise 85-027 were by means of a Benthos piston corer (6.7 cm I.D.), whereas cores collected during 90-023 were by means of the AGC large diameter corer (9.9 cm I.D.). Navigational positioning during Cruise 85-027 was mainly by BIONAV, the Bedford Institute of Oceanography integrated navigation system that utilizes rho-rho Loran C, Satellite navigation, log and gyro, and by radar. Positioning during Cruise 90-023 was primarily by Navstar GPS which was available approximately 20 hours per day, supplemented by Loran C, NNSS satellite, and by log and gyro.

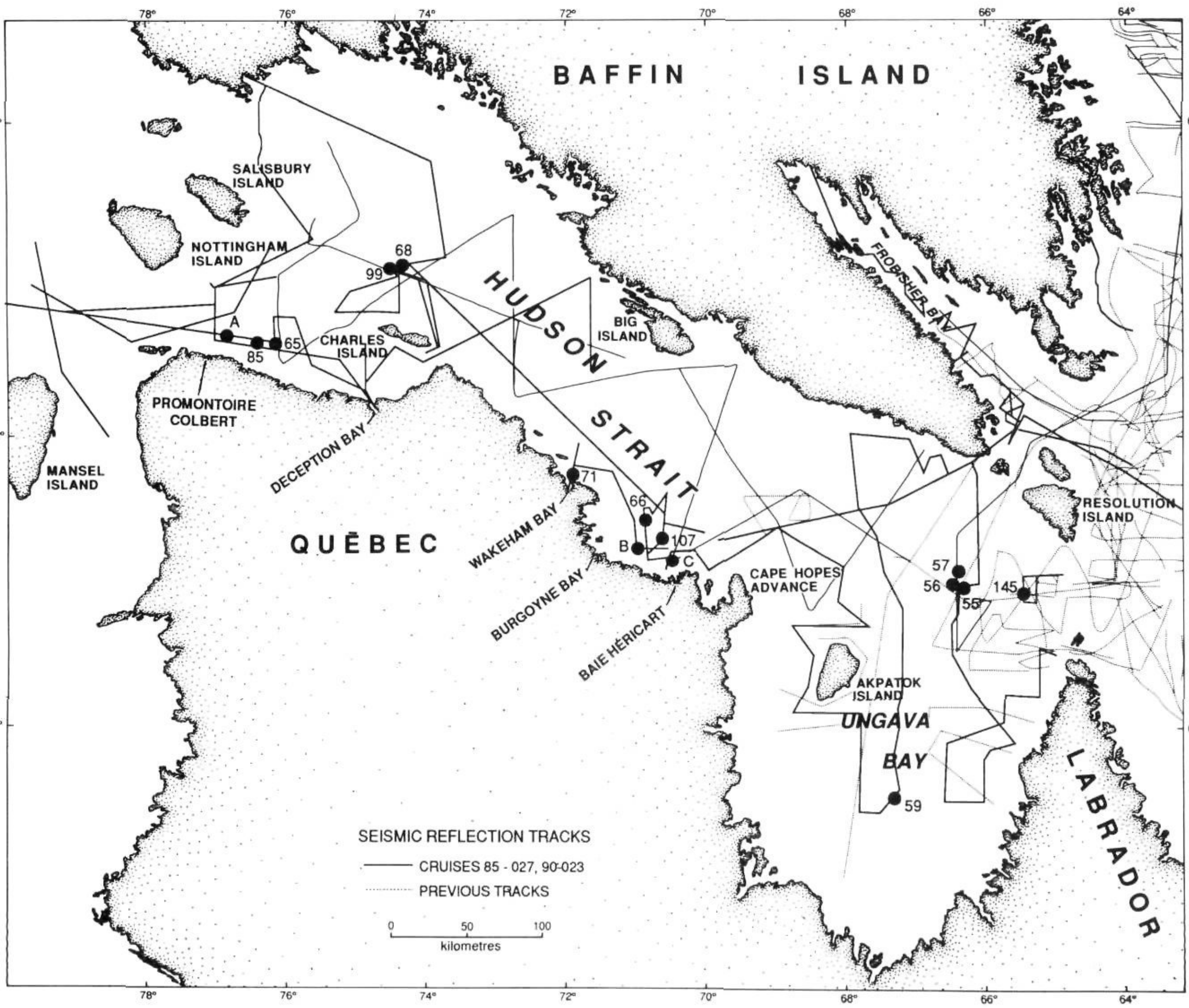


FIGURE 2. Map showing survey tracks and locations of cores and profile sections.

Lignes de sondes et localisation des carottes et des profils.

PREVIOUS STUDIES

Present knowledge of the late Quaternary history of the Hudson Strait region comes from studies conducted both offshore and at localities onshore. The following is a selective summary of this previous work. For further regional information readers are referred to: Dyke and Prest (1987 a, b), Andrews *et al.* (1983), Andrews (1989), and to Piper *et al.* (1990).

Preliminary information on the late Quaternary sediments in eastern Hudson Strait and Ungava Bay was provided by seismic reflection surveys (Grant and Manchester, 1970) and by a sediment core from easternmost Hudson Strait (Fillon and Harmes, 1982). Regional information on the general distribution, composition, and depositional environments of Quaternary sediments and information on the composition and age of the underlying bedrock within Hudson Strait was provided by reconnaissance surveys with high resolution seismic systems, bedrock borehole drilling, and coring of sediments in the three main basins (MacLean *et al.*, 1986). From these sediment cores Vilks *et al.* (1989) were able to establish a biostratigraphic framework for the late Quaternary sediments. In 1990, MacLean *et al.* (1991) conducted extensive regional marine surveys to further delineate sediment deposits, depositional environments, chronologies, and the late glacial-deglacial history. Andrews *et al.* (1991) presented preliminary magnetic susceptibilty data from cores from the eastern basin in Hudson Strait and offshore from Baie Héricart.

Onshore, studies on Meta Incognita Peninsula of southern Baffin Island by Blake (1966) and Clark (1985) indicated ice flow southward toward Hudson Strait with impingement of eastward flowing ice in a narrow zone along the coast. Deglaciation had progressed to the Big Island area by *ca.* 8000 BP. Near the eastern end of Meta Incognita Peninsula, however, striae and carbonate-rich till indicated ice flow to the northeast. Further studies of eastern Meta Incognita Peninsula (see Stravers, 1986; and Miller *et al.*, 1988) found evidence of multiple glaciations and deposition by northeasterly flowing ice of a till whose provenance suggested that it was derived from Ungava Peninsula. From this evidence, together with data from studies on Hall Peninsula and Loks Land (Miller, 1985) and from the adjacent continental shelf (Praeg *et al.*, 1986; Josenhans *et al.*,1986), northeasterly flowing ice was postulated to have crossed Hudson Strait and to have overridden parts of southeastern Baffin Island and continental shelf (Osterman *et al.*, 1985; Stravers, 1986; Miller *et al.*, 1988; Andrews, 1989). Miller and Kaufman (1990) interpreted three such advances between 11,500 and 8000 BP, the latest of which extended only to Meta Incognita Peninsula. They suggested that ice flux from this region together with waters draining from Lake Agassiz through the St. Lawrence River system may have been responsible for the Younger Dryas period of cooling.

The late Quaternary geology of northern Labrador has been studied in a number of areas (see Clark, 1988, 1990). Klassen (1990), from relationships associated with glacial lakes, postulated that glacial ice remained in Ungava Bay after Labrador Peninsula was deglaciated.

Investigations of Akpatok Island in Ungava Bay undertaken by Løken (1978) and Gray et *al.* (1990) provided evidence of: postglacial tilting of the island; eastward flowing ice in the western part of the island, which retreated before 7200 BP; northward moving ice in the southeastern part of the island; and an open marine environment by 6900-6500 BP.

A convergent pattern of ice flow occurred from Ungava Peninsula into southern and western Ungava Bay. Deglaciation of the southern part of the Bay did not occur until *ca.* 7300-7000 BP and glacial ice remained nearby until 6500 BP and later (Gray and Lauriol, 1985; Lauriol and Gray, 1987; Allard *et al.*, 1989).

Ice flow on northern Ungava Peninsula was northward except at the coast which was slightly overridden by eastward flowing ice (Gray and Lauriol, 1985; Bruneau *et al.*, 1990). Dates on shells from glaciomarine sediments exposed onshore indicate that deglaciation occurred in the Deception Bay area by 9400-9600 BP (Bruneau *et al.*, 1990; Gray *et al.*, 1985, 1992, in press) and possibly as early as 10,700 BP (Kaufman *et al.*, 1992).

Ice flow on Nottingham, Salisbury, and Mill islands at the western end of the Strait was eastward, whereas it was northward on adjacent Ungava Peninsula, and southward on Foxe Peninsula, except for the eastward flow on the coastal tips of each. These islands and northern Ungava were not deglaciated before 8100 BP and the southern coast of Foxe Peninsula, not before 7700 BP (Laymon, 1988). From marine studies in Hudson Bay Josenhans and Zevenhuizen (1990) concluded that deglaciation there was rapid and dynamic.

BEDROCK GEOLOGY

Data from shallow borehole samples and regional seismic surveys indicate that Lower Paleozoic sedimentary rocks underlie much of Hudson Strait and form Akpatok Island and the central plafform in Ungava Bay (Grant and Manchester, 1970; MacLean *et al.*, 1986; Miller and Williams, 1988; Workum *et al.*, 1976). These are principally carbonate rocks of Late Ordovician age with Silurian strata possibly represented in the southeastern part of the Strait and west and southwest of Charles Island. Younger strata may be present locally in the basin in eastern Hudson Strait (Grant and Manchester, 1970; MacLean *et al.*, 1986).

QUATERNARY SEDIMENTS

SEISMOSTRATIGRAPHY

The regional surveys with shallow and high resolution seismic systems, together with textural and paleontological data from sediment cores, indicate the presence of five seismostratigraphic units interpreted to comprise glacial drift, glaciomarine (proximal and distal), early and later postglacial deposits, and locally, possible debris flow sediments (MacLean *et al.*, 1986, 1991; Vilks *et al.*, 1989) .

The acoustic character and stratigraphic relationships of the seismostratigraphic units recognized in Hudson Strait have been described in the publications cited above, as well as their general similarity in character to sediments in other northern latitude offshore areas. Therefore, only a brief resume of those characteristics is included here. The units

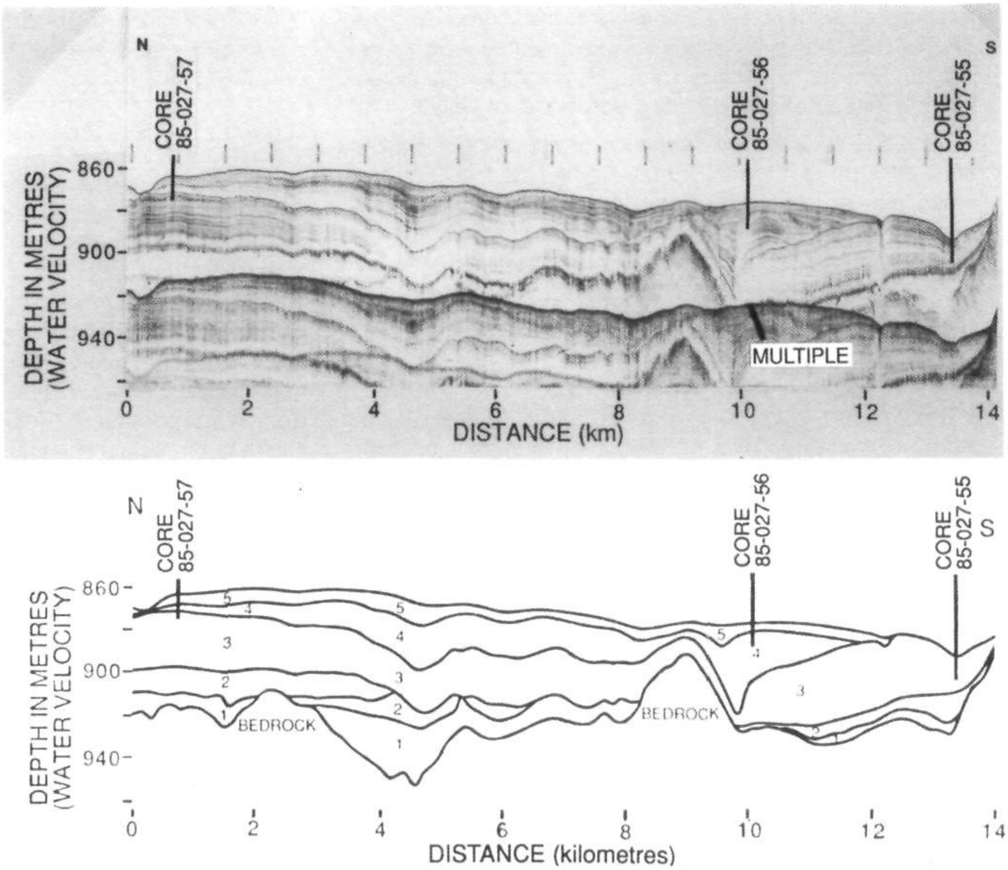


FIGURE 3. Huntec high resolution profile north-south across the western part of the eastern basin in Hudson Strait illustrating seismic units and relationships to core localities. Interpretation of the area below the multiple on the Huntec record is derived from shallow seismic reflection profiles (see Fig. 2 for location). (From Vilks *et al.*, 1989.)

Profil Huntec de haute résolution nord-sud à travers la partie ouest du bassin est du détroit d'Hudson montrant les unités sismiques et les liens avec les sites de carottage. L'interprétation de la zone située sous la ligne dite "multiple" sur le profil Huntec découle des profils de sismique réflexion peu profonde (de Vilks et al., *1989) (localisation à la fig. 2).*

are exemplified by Figure 3 from the eastern basin in Hudson Strait and by Figures 4 and 5 from the basin west-southwest of Charles Island in the western part of the Strait. Unit 1 is an acoustically unstratified sediment with a relatively dense acoustic return that occurs at the base of the unconsolidated sediment section (Figs. 4, 5). Textural and physical property data are not available for sediments of Unit 1 in Hudson Strait and Ungava Bay. Acoustically similar sediments sampled on the southeastern Baffin shelf (Praeg *et al.*, 1986), in Barrow Strait (MacLean *et al.*, 1989), and on the Scotian Shelf (King and Fader, 1986) are diamictons comprising unsorted, cohesive mixtures of sand, gravel, silt and clay interpreted to be glacial drift. On the basis of the acoustic, stratigraphic, and seismic facies similarities with those other areas, sediments of Unit 1 in Hudson Strait and Ungava Bay are interpreted to be glacial drift comprising subglacial deposits of till and other ice contact sediments. In some localities the unit has a less dense acoustic character possibly reflecting a lower degree of compaction or higher water content.

Unit 2 overlies sediments of Unit 1 in the three main basins of the Strait. It is acoustically unstratified, but commonly is more acoustically transparent than Unit 1. On the basis of its unstratified acoustic character, stratigraphic position, lateral

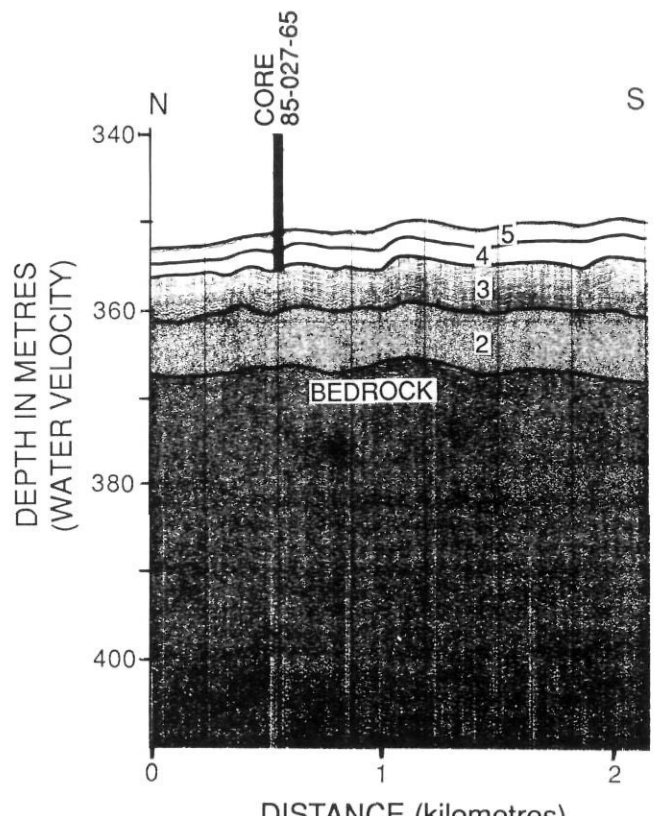


FIGURE 4. Huntec high resolution profile illustrating sediment units at Core 85-027-65 locality in the basin southwest of Charles Island in western Hudson Strait (see Fig. 2 for location).

Profil Huntec de haute résolution montrant les unités sédimentaires au site de la carotte 85-027-65 dans le bassin au sud-ouest de Charles Island, dans la partie ouest du détroit d'Hudson (localisation à la fig. 2).

relations and extent, Unit 2 appears to also comprise glacial drift. Locally, however, debris flow sediments may be represented. Sediments of Units 1 and 2 in places are transitional laterally to acoustically stratified sediments of Unit 3.

Unit 3 is a distinctive sequence of acoustically stratified sediments up to 30 m thick that overlie Unit 1 or 2 in basin areas in a draped depositional style that mimics the irregular underlying surface (Fig. 3). In many localities, especially in basin margin settings, these sediments intertongue with and are laterally transitional to glacial drift of Units 1 or 2. Foraminiferal data indicate that the acoustically stratified sediments of Unit 3 were deposited in glaciomarine ice-proximal and ice-distal environments.

Sediments of Unit 4 are best defined in the eastern Hudson Strait basin (Fig. 3) where they form an acoustically stratified sequence conformably overlying Unit 3, but of more variable aspect due to local thickening and thinning. Acoustically weakly stratified beds overlying Unit 3 in the basin southwest of Charles Island tentatively have been ascribed to Unit 4 (Fig. 4, 5). Acoustically weakly stratified beds of Unit 5 overlie sediments of Units 3, and 4 where present, in a basin fill depositional style (Fig. 3). These are the most recent of the seismostratigraphic units and are postglacial in origin as indicated by the foraminiferal assemblages present.

SEDIMENT DISTRIBUTION

Deposits of glacial drift represented by Units 1 and 2 are widespread and in places form moraines and contain multiple drift sequences (*e.g.*, Fig. 6). Deposits of glaciomarine and postglacial sediments are mainly confined to basinal areas. The greatest accumulations of Quaternary sediments, comprising glacial drift, glaciomarine, and postglacial sediments, occur in the three principal Hudson Strait basins, where thicknesses reach 130 m, but thick sediment deposits also occur along the south side of the Strait, in adjoining bays and fiords, and in the marginal channel surrounding the central plateau in Ungava Bay. Glacial and glaciomarine sediments predominate in many areas investigated along the south coast as a result of their proximity to former glacial ice margins on and offshore Ungava Peninsula. Postglacial sediments appear to form a greater part of the section in southern Ungava Bay presumably as a consequence of fluvial and meltwater input from the adjacent large terrestrial drainage basin.

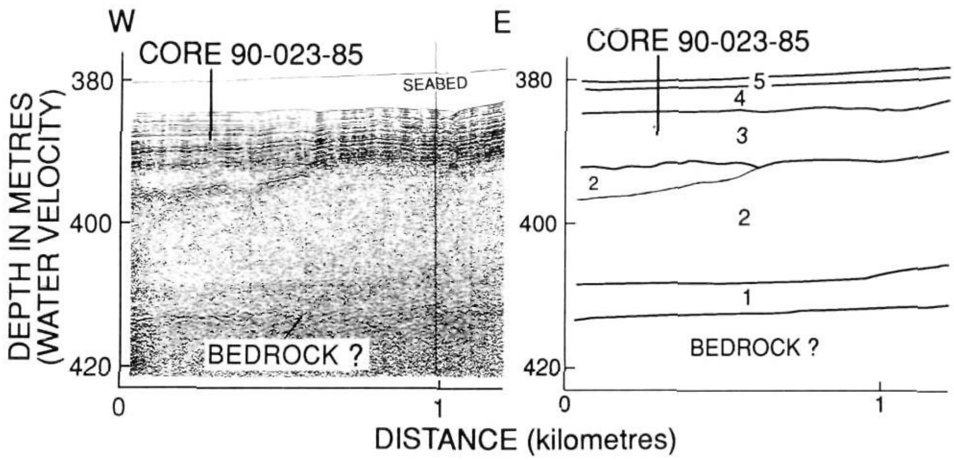


FIGURE 5. Huntec high resolution profile illustrating glacial drift (1, 2), glaciomarine (3), and postglacial (4, 5) sediment units at Core 90-023-85 locality in southwestern Hudson Strait (see Fig. 2 for location). Unit 2 locally contains two or more drift sequences.

Profil Huntec de haute résolution illustrant les unités sédimentaires au site de la carotte 90-023-85 au sud-ouest de détroit d'Hudson (localisation à la fig. 2): dépôts glaciaires (1, 2) sédiments glaciomarins (3) et sédiments postglaciaires (4, 5). Localement, l'unité 2 renferme deux ou plusieurs séquences.

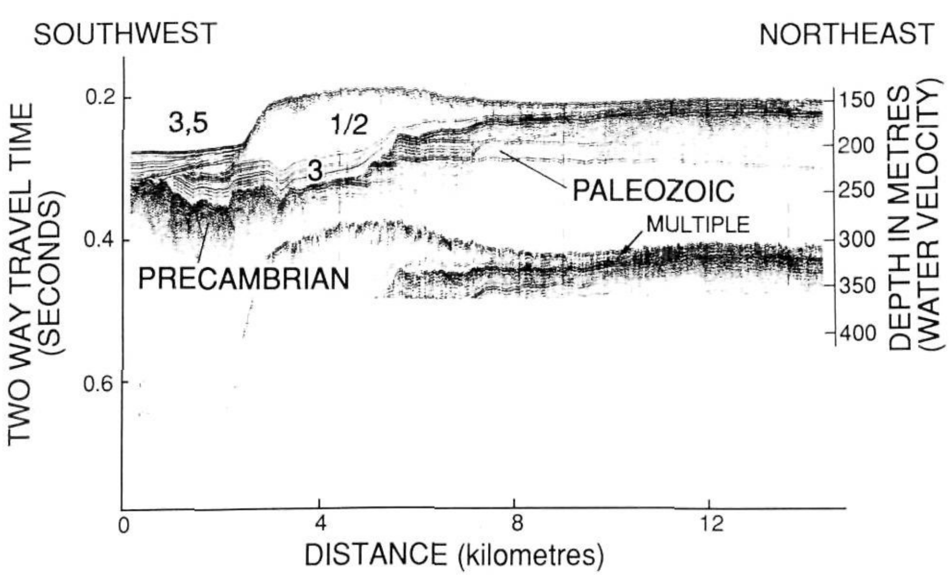


FIGURE 6. Seismic reflection profile illustrating a moraine up to 70 m thick lying on acoustically stratified sediments, inferred to be glaciomarine sequences, 20 km offshore from Baie Héricart in south central Hudson Strait. The boundary between Precambrian and Paleozoic rocks occurs approximately 3 km along section (see locality C on Fig. 2).

Profil de sismique réflexion montrant une moraine d'une épaisseur allant jusqu'à 70 m reposant sur des sédiments stratifiés (selon les ondes acoustiques) supposés d'origine glaciomarine, à 20 km au large de la baie Héricart, au centre sud du détroit d'Hudson. La limite entre les roches précambriennes et paléozoïques se trouve à environ 3 km le long de la coupe (voir le site C sur la fig. 2).

The level of definitive data on sediments in the inter basin areas as yet is significantly less than in the basins. Acoustic profile data indicate that these areas mainly contain acoustically unstratified sediments that range in thickness from a few metres or less to ten metres or more. The seafloor sediments in most areas have been extensively ice scoured, and in places an ice keel turbate may have developed. The immediate seabed commonly contains gravel and sand size components (and in places shell hash), which may be lag deposits resulting from current winnowing, but may also include ice transported components. On the basis of their acoustic characteristics the sediments in many of these areas are thought primarily to be glacial drift. IKU clam shell samples of stiff silty and clayey sediments found underlying the coarse surface layer in a few localities contain postglacial, and in two instances, glaciomarine foraminiferal assemblages. These indicate that such sediments occur at least locally in some of the inter-basin areas.

REGIONAL DATA

The following sections present seismic, biostratigraphic, and chronological information from the main sediment localities.

Eastern Hudson Strait

Three cores, 85-027-55, -56, and -57 from the western part of the deep eastern basin in Hudson Strait provide information on depositional environments and paleoceanographic conditions, and some chronological data for that region (Vilks *et al.*, 1989).

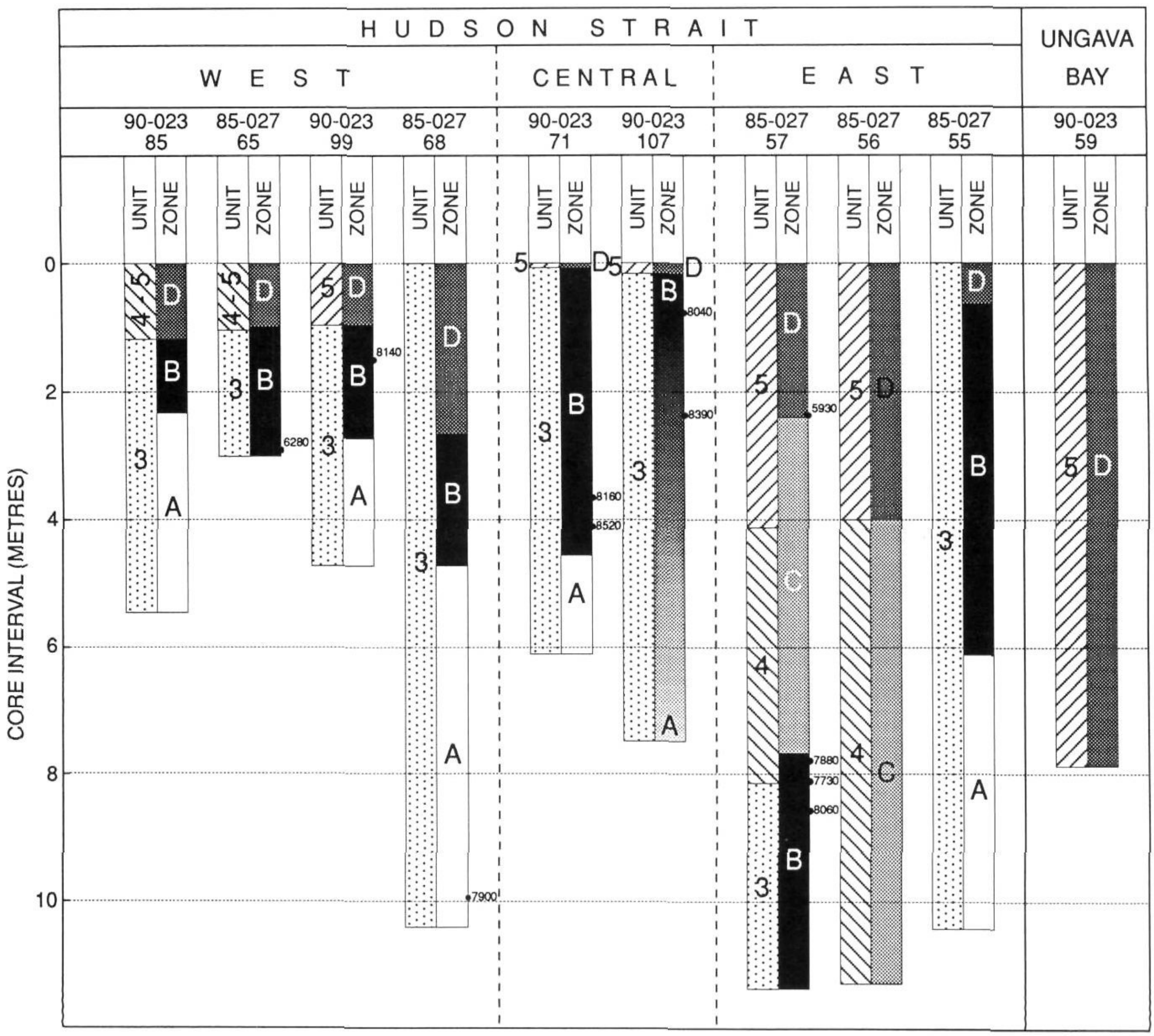


FIGURE 7. Chart showing faunal zones, seismic units, and age dates (radiocarbon years BP, adjusted by 410 yr reservoir effect; see Table I) for Cores 85-027-55, 56, 57, 65, and 68; and 90-023-59, 71, 85, 99 and 107.

Diagramme montrant les zones fauniques, les unités sismiques et les datations (avec un facteur de correction de 410 ans en fonction de l'effet de réservoir: voir le tabl. I) des carottes 85-027-55, 56, 57, 65 et 68; et 90-023-59, 71, 85, 99 et 107.

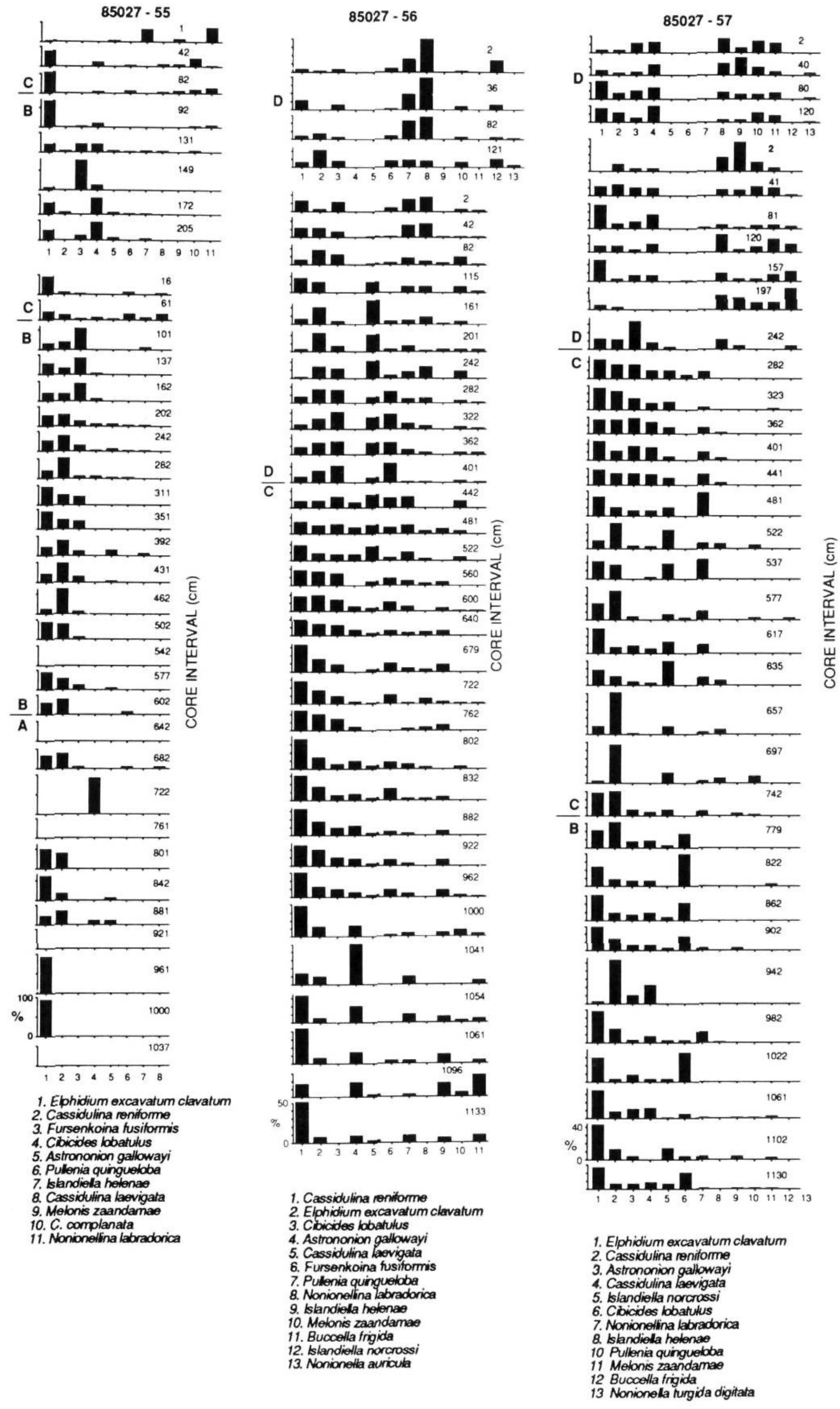


FIGURE 8. Relative abundance in per cent of major foraminifera species in sediments in trigger weight (top) and piston cores 85-027-55, 56, 57 from the eastern basin in Hudson Strait. A-D are Faunal Zones (from Vilks *et al.*, 1989).

Abondance relative (en %) des principales espèces de foraminifères dans les sédiments obtenus par carottier déclencheur (en haut) et à piston des carottes 85-027-55, 56 et 57 dans le bassin à l'est du détroit d'Hudson. A, B, C, D sont des zones fauniques (de Vilks et al.*, 1989).*

The setting and positions of these cores relative to the sediment section are indicated in Figure 3. From studies of foraminifera together with sediment texture in these cores Vilks *et al.* (1989) established a biostratigraphic framework and correlation of faunal zones and seismic units. The Quaternary sequences represented at this locality were interpreted to include glacial drift, glaciomarine ice proximal (Faunal Zone A), glaciomarine ice distal (Faunal Zone B), early postglacial (Faunal Zone C), and late postglacial deposits (Faunal Zone D) (Fig. 7). Glacial drift was not sampled at these localities but where sampled elsewhere it has been faunally barren. The following summary of Faunal Zone information is drawn from Vilks *et al.* (1989) and the reader is referred to that publication for greater detail.

Faunal Zone A (Figs. 8, 9) is characterized by the presence of *Elphidium excavatum clavatum* and *Cassidulina reniforme*, low diversity of fauna, and frequent barren intervals. It is interpreted to represent a proximal glacialmarine environment.

Faunal Zone B (Figs. 8, 9) is marked by the addition of *Fursenkoina fusiformis* to the fauna present in Zone A. This zone is interpreted to represent a glaciomarine ice distal environment.

Faunal Zone C (Figs. 8, 9) is characterized by the addition of *Cassidulina laevigata, Pullenia quinqueloba* and *Astrononion gallowayi* to the Zone A species. Zone C fauna have not been found in the Strait west of the deep eastern basin. This Zone was interpreted by Vilks *et al.* (1989) to represent early postglacial conditions with the presence of more saline, and warmer Labrador Sea waters in greater proportions than in the present day in eastern Hudson Strait. The depositional style of corresponding Seismic Unit 4 (Fig. 3), which contains lens shaped accumulations, and local thickening and thinning suggests the effect of increased bottom currents relative to those that prevailed during deposition of Faunal Zone A and B (Seismic Unit 3) sediments.

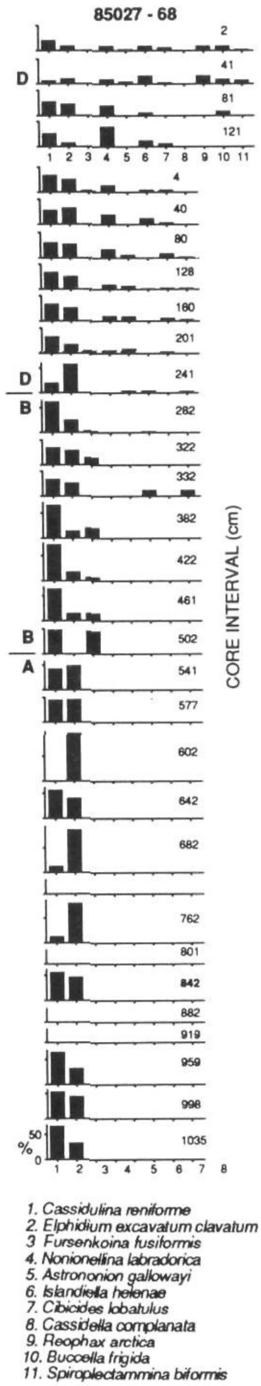
Faunal Zone D (Figs. 8, 9) is characterized by the addition of *Nonionellina labradorica, Islandiella helenae* and *Astrononion gallowayi*. Vilks *et al.* (1989) interpreted the Zone D species to be indicative of an increasing effect of Arctic-Subarctic inner shelf waters in a late postglacial setting.

Chronological information on these sediments comes from dates on shells in Core 57 reported by Vilks *et al.* (1989) (Table I, Fig. 7). An AMS date of 7730 ± 70 BP[1] (To-749) on paired *Portlandia arctica* valves from Core 57 interval 814-822 just above the Faunal Zone B-C boundary approximately dates the change from glaciomarine ice distal to early postglacial conditions in the western part of the Hudson Strait eastern Basin. Vilks *et al.* (1989) considered the time span between this date and Fillon and Harmes (1982) date of 8730 ± 250 BP (GSC-2698) from sediments near the top of Faunal Zone B at a core locality (Core HU77-154) 60 km east of Core 57 to be evidence of very gradual westward migration of early postglacial paleoceanographic conditions in the eastern part of the Strait following ice retreat.

1. Dates reported in this paper on samples from cores collected in marine areas of Hudson Strait during cruises 85-027 and 90-023 are age corrected for a 410 yr reservoir effect (see Table I).

South Central Hudson Strait

The southern part of Hudson Strait bordering Ungava Peninsula from Ungava Bay westward to the entrance to Hudson Bay contains an important sedimentary record relating to late glacial and deglacial events both onshore and offshore from Ungava Peninsula, and is one of the prime areas to understanding the timing and manner of deglaciation of Hudson Strait. The Baie Héricart-Wakeham Bay area is one of the key offshore areas in this region. Cores were collected at several sites close to former ice margins in this region to obtain information on late glacial chronologies, depositional environments, and paleoceanographic conditions.



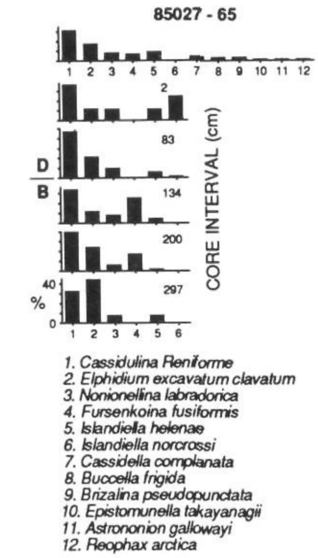


FIGURE 9. Relative abundance in per cent of major foraminifera species in sediments in trigger weight (top) and piston cores 85-027-65 and 68 from the basins in western Hudson Strait. A-D are Faunal Zones (from Vilks *et al.*, 1989).

Abondance relative (en %) des principales espèces de foraminifères dans les sédiments obtenus par carottier déclencheur (en haut) et à piston des carottes 85-027-65 et 68 dans les bassins à l'ouest du détroit d'Hudson. A, B, C, D sont des zones fauniques (de Vilks et al., *1989).*

High resolution seismic reflection data indicate that the late glacial ice margin stood offshore in the Wakeham Bay-Baie Héricart region and that some readvance of late glacial ice occurred (Figs. 1, 6, 10, 11). The data suggest that this readvance was of limited extent. In the eastern part of this region, some 20 km north (offshore) from Baie Héricart (Fig. 1), glacial drift forms a moraine up to 70 m thick which lies on acoustically stratified sediments that are interpreted to be glaciomarine (Fig. 6). The stratigraphic relations and chronological data from adjacent cores indicate that the glacial drift was deposited by a late readvance of glacial ice across previously deposited glaciomarine sediments. Ice loading, however, was not sufficient to remove or substantially disrupt the previous sediments. This suggests that the ice sheet was almost buoyant, and only lightly bearing on the seabed (MacLean and Vilks, 1992).

Twenty kilometres to the north-northwest, Core 90-023-107 was obtained from a sequence of acoustically stratified sediments (Unit 3) that laterally inter-tongue with and are transitional to glacial drift some 2.5 km from the core site (Figs. 2, 10). A similar transition (not shown) occurs an equal distance to the south. There, the glacial drift illustrated in Figure 10 overlies two more acoustically massive drift sequences. The acoustic data suggest that the basal beds of Unit 3 are transitional to the uppermost of these lower drift sediments 3 km south of the core site. These were overridden by the later readvance. Approximately 3 m of acoustically unstratified sediments of Unit 5 overlie sediments of Unit 3.

Foraminifera in Core 90-023-107 indicate that sediments in the lower part of the sequence sampled by the corer comprise Faunal Zone A (Figs. 7, 12), indicative of deposition in

TABLE I
Radiocarbon dates

Sample Identification	Description	Weight (g)	Lab. No.	Age* (yrs BP) Corrected for 410 yr. reservoir effect
85027-57 (242-246 cm)	foraminifera	0.019	To-1870	5930 ± 70[1]
85027-57 (782-788 cm)	*Portlandia arctica* valve	0.051	To-748	7880 ± 70[1]
85027-57 (814-822 cm)	*Portlandia arctica* paired shell	0.260	To-749	7730 ± 70[1]
85027-57 (862-870 cm)	*Portlandia arctica* valve	0.041	To-750	8060 ± 70[1]
85027-65 (294-299 cm)	*Clinocardum cilatum* valve	0.610	To-293	6280 ± 50[1]
90023-66 (230 cm)	*Portlandia arctica* valve	0.093	To-2461	7940 ± 80[2]
90023-66 (728 cm)	*Portlandia arctica* valves	0.224	To-2463	8440 ± 90[2]
90023-66 (743 cm)	*Portlandia arctica* valves	0.080	To-2464	8420 ± 80[2]
85027-68 (989-996 cm)	*Portlandia arctica* fresh fragments	0.064	To-751	7900 ± 70[1]
90023-71 (360-362 cm)	*Portlandia arctica* valve	0.014	To-2465	8160 ± 230[2]
90023-71 (408 cm)	*Portlandia arctica* valves	0.448	To-2466	8520 ± 80[2]
90023-099 (150 cm)	shell fragments	0.300	To-2470	8140 ± 160[2]
90023-107 (80-82 cm)	*Portlandia arctica* valves	0.066	To-2471	8040 ± 70[2]
90023-107 (236 cm)	shell fragments	0.124	To-2472	8390 ± 70[2]

* By Accelerator Mass Spectrometry
[1] Fractionation corrected to a base of $\delta^{13}C$ = 0 % which is equivalent to a reservoir correction of 410 years.
[2] Fractionation corrected to a base of $\delta^{13}C$ = −25 %, and a 410 year reservoir effect correction has been applied.

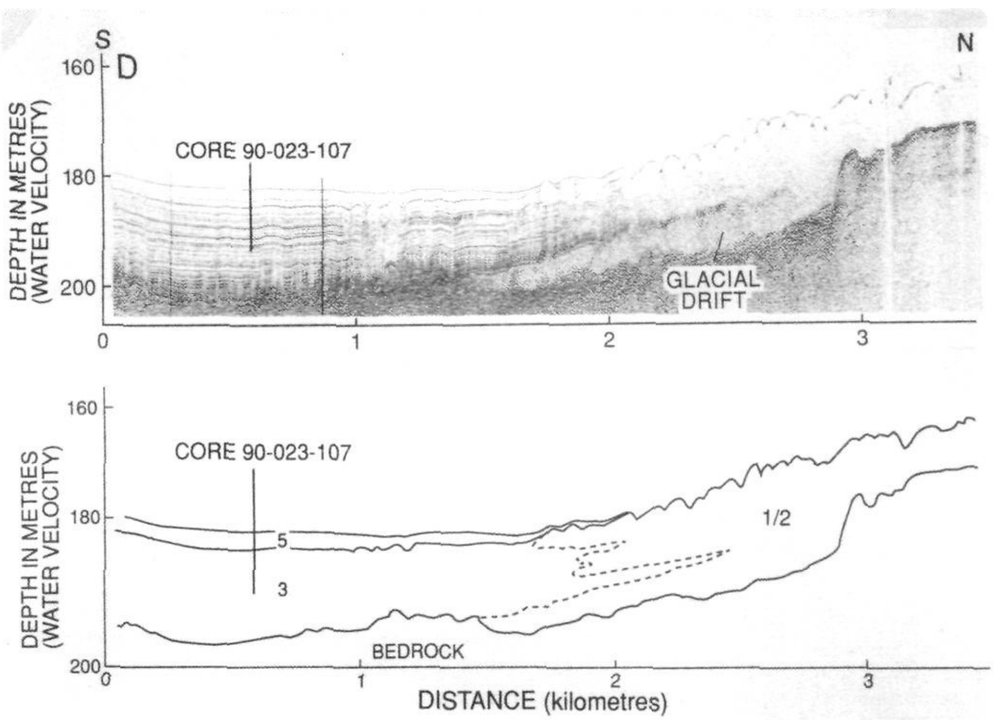


FIGURE 10. Huntec high resolution seismic reflection profile showing glacial drift (1/2), glaciomarine (3), and postglacial (5) units at Core 90-023-107 locality in south central Hudson Strait. Acoustically stratified glaciomarine sediments of Unit 3 are transitional to glacial drift some 2.5 km from the core site. Uppermost sediments of Unit 1/2 on the right display irregular ice scoured morphology and may include ice keel turbate (see Fig. 2 for location).

Profil Huntec de sismique réflexion de haute résolution montrant les unités de dépôts glaciaires (1/2), de sédiments glaciomarins (3) et de sédiments postglaciaires au site de la carotte 90-023-107, au centre sud du détroit d'Hudson. La transition des sédiments glaciomarins stratifiés de l'unité 3 aux dépôts glaciaires se fait à environ 2,5 km du site de forage. Les sédiments les plus élevés de l'unité 1/2 (à droite) montrent une morphologie irrégulière d'érosion glaciaire et peut-être des marques laissées par des quilles de banquise (localisation à la fig. 2).

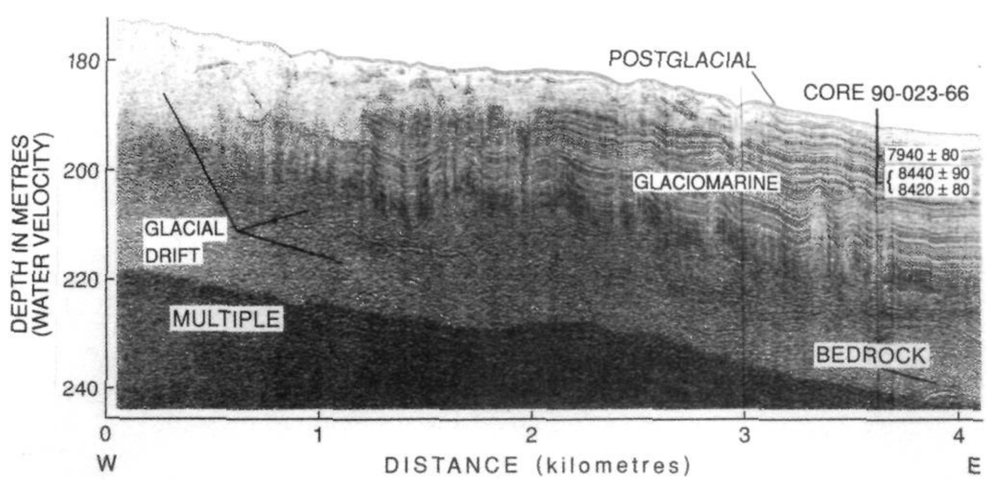


FIGURE 11. Huntec high resolution seismic reflection profile illustrating sediments at the site of Core 90-023-66 in south central Hudson Strait. Acoustically stratified glaciomarine sediments are transitional to glacial drift 2-3 km west of the core site (see Fig. 2 for location).

Profil Huntec de sismique réflexion de haute résolution montrant les sédiments au site de la carotte 90-023-66, au centre sud du détroit d'Hudson. La transition des sédiments glaciomarins stratifiés (selon les ondes acoustiques) aux dépôts glaciaires se fait à 2-3 km à l'ouest du site de forage (localisation à la fig. 2).

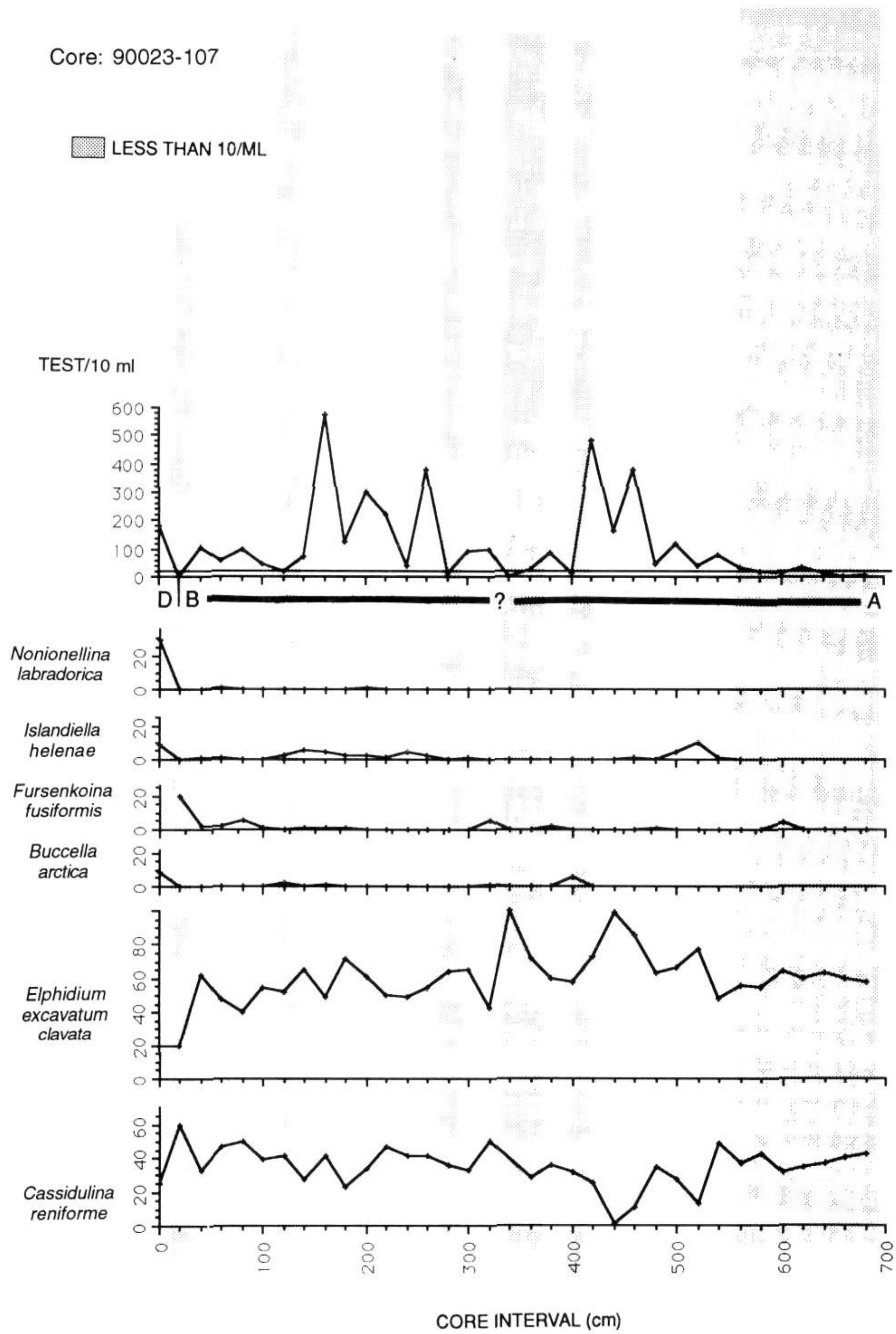
a glaciomarine ice proximal environment. This environment, with some apparent fluctuations, extended to near the top of Unit 3 where more ice distal influences gradually appear. Faunal Zone D foraminifera indicative of a postglacial depositional environment correlate with Seismic Unit 5. Approximately 2.8 m of sediment at the top of the sediment section were not recovered by the corer. The faunal evidence agrees well with the proximal setting indicated by the seismic data.

AMS dates were obtained from shells from two intervals in Core 90-023-107 (Table I, Fig. 7). Mollusc shell fragments from a depth of 236 cm yielded a date of 8390 ± 70 BP (To-2472). Two *Portlandia arctica* valves plus fragments from interval 80-82 cm yielded a date of 8040 ± 70 BP (To-2471).

Eighteen kilometres to the northwest, Core 90-023-66 was collected in a proximal glacial ice margin setting relatively similar to that at the Core 107 locality (Figs. 2,11). Acoustically stratified sediments are transitional to glacial drift 2.5-3 km west of the core site in the lower part of the section, but were overridden by a later advance of glacial ice that extended to within approximately 1 km of the core site. Studies of foraminifera in Core 90-023-66 have not yet been completed, but AMS dates have been obtained on shells from three intervals (Table I). A complete specimen of *Portlandia arctica* from a depth downcore of 743 cm yielded a date of 8420 ± 80 BP (To-2464). Three complete specimens of *Portlandia arctica* from a depth of 728 cm yielded a date of

FIGURE 12. Abundances (per cent) of major foraminifera species in Core 90-023-107. Shaded areas contain < 10 foraminifera tests per ml.

Abondance (en %) des principales espèces de foraminifères dans la carotte 90-023-107. Les parties tramées renferment < 10 tests de foraminifères/ml.



8440 ± 90 (To-2463), and one *Portlandia arctica* valve from a depth of 230 cm yielded a date of 7940 ± 80 BP (To-2461).

To the southwest, Huntec high resolution seismic reflection data indicate the presence of a significant sediment deposit containing up to 60 m of acoustically stratified and transparent sediments off Burgoyne Bay (Figs. 2, 13). The depositional pattern portrayed by the acoustic data resembles that in the western part of the eastern Hudson Strait basin (Fig. 3). The lowermost 25 m of the acoustically stratified sediments conform to the shape of the underlying surface and laterally underlie and are in part transitional to sediments that we consider to be glacial drift (Figs. 13, 14), in a manner similar to that seen at core localities 107 and 66 and in the area off Baie Héricart (Figs. 6, 10, 11). The basal acoustically stratified sediments are interpreted to represent glaciomarine sediments of Seismic Unit 3. The overlying beds onlap the lower beds toward the basin margins and laterally overlie the glacial drift (Fig. 13). They and the acoustically transparent beds in the uppermost part of the sequence may be stratigraphic equivalents of Seismic Units 4 and 5 in the eastern basin, where they represent early and late postglacial sediments respectively.

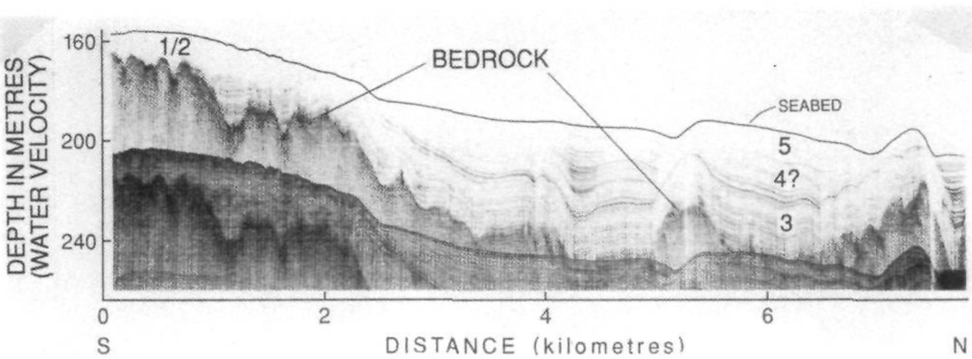


FIGURE 13. Huntec high resolution profile illustrating the thick (up to 60 m) sediments in the Burgoyne Bay region of south central Hudson Strait. These are inferred to comprise glaciomarine and postglacial deposits. The style of deposition of these sediments resembles that in the eastern basin in Hudson Strait (Fig. 3) (see location B in Fig. 2).

Profil Huntec de haute résolution montrant la grande épaisseur de sédiments (jusqu'à 60 m) dans la région de la baie Burgoyne, au centre-sud du détroit d'Hudson. On suppose qu'ils comprennent des dépôts glaciomarins et postglaciaires. Le mode de mise en place rappelle celui du bassin à l'est du détroit d'Hudson (fig. 3) (site B de la fig. 2).

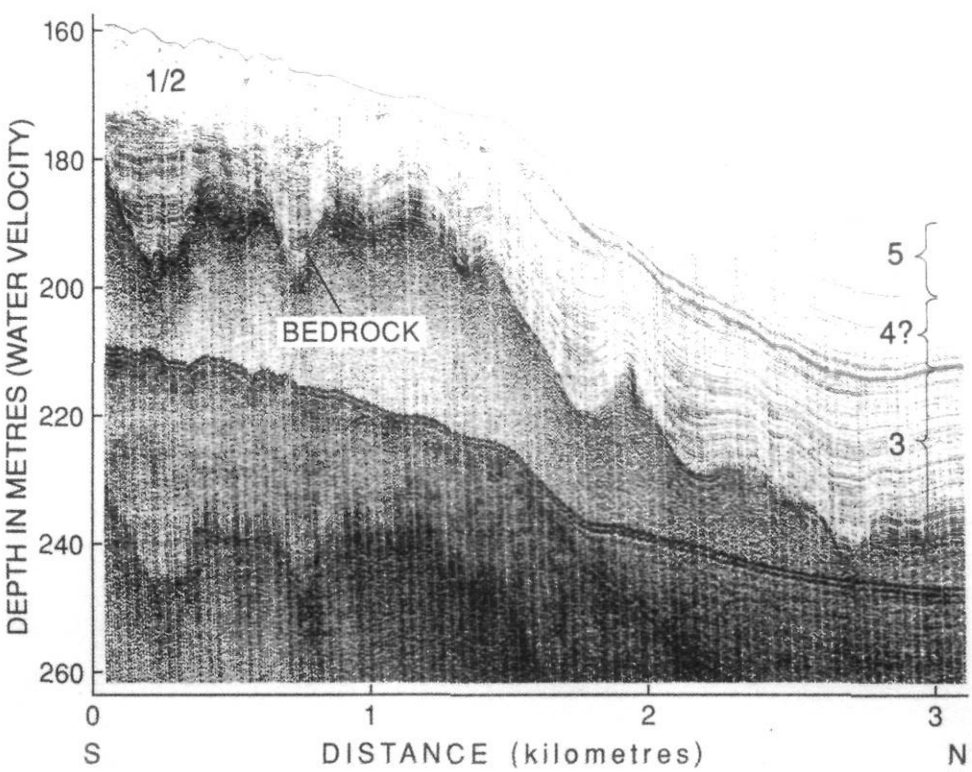


FIGURE 14. Huntec high resolution seismic reflection profile showing in more detail a tongue of Unit 1/2 glacial drift sediments overlying and laterally transitional to Unit 3 glaciomarine sediments at the southern end of the section in Figure 13. Seabed sediments have been modified by grounding ice keels at the south end of the profile.

Profil Huntec de sismique réflexion de haute résolution montrant de façon plus détaillée une lentille des sédiments glaciaires de l'unité 1/2 sus-jacents et latéralement transitionnels aux sédiments glaciomarins de l'unité 3, à la limite sud de la coupe de la figure 13. Les sédiments sur les fonds marins ont été perturbés par des quilles de banquise dans la partie sud du profil.

Core 90-023-71 was collected at a locality sixty-eight kilometres northwest of the Core 90-023-66 site and 9 km offshore from the entrance to Wakeham Bay (Figs. 2, 15). This locality like Core 66 and 107 sites, is in close proximity to a former glacial ice margin. High resolution seismic profile data (Fig. 15) indicate that the core site is underlain by 24 m of acoustically stratified sediments of Unit 3 which lie on glacial drift, and are themselves overlain by about 1.5 m of acoustically transparent sediments of Unit 5. The upper part of Unit 3 is transitional to glacial drift 0.7 km north of the core site, but sediments in the basal 5-10 m extend an additional 1.7 km beneath drift deposited by an ice readvance. Foraminiferal assemblages indicate that the boundary between Faunal Zones A and B occurs 450 cm below the top of Seismic Unit 3. Only 10 cm of the overlying sediments of Faunal Unit D (Seismic Unit 5) were recovered by the corer.

AMS dating of complete specimens of *Portlandia arctica* from down core depths of 360-362 cm and 408 cm in the glaciomarine sediments yielded ages of 8160 ± 230 BP (To-2465) and 8520 ± 80 BP (To-2466) (Table I, Fig. 7).

Western Hudson Strait

A preliminary general outline of the regional seismo- and bio-stratigraphic setting in marine areas of western Hudson Strait as obtained from reconnaissance surveys and core samples was presented by MacLean *et al.* (1986, 1991), and Vilks *et al.* (1989). The discussion here summarizes the biostratigraphic framework established by Vilks *et al.* (1989) from cores in the basins north and southwest of Charles Island, and presents data on glaciomarine and postglacial sediments from two additional cores collected in these areas in 1990.

Core 85-027-65 from a site in the southwestern basin 77 km west-southwest of Charles Island and 24 km offshore from the Ungava Peninsula (Figs. 2, 4) penetrated acoustically transparent sediments and approximately one metre into

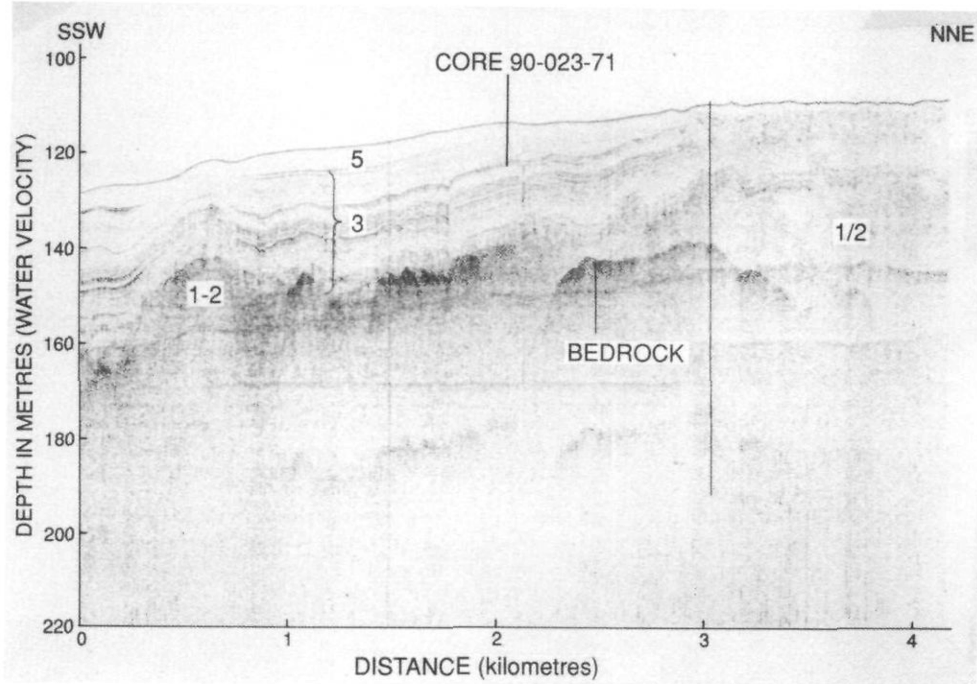


FIGURE 15. Huntec high resolution seismic reflection profile illustrating the setting at Core 90-023-71, 9 km off the entrance to Wakeham Bay in south central Hudson Strait. The acoustically stratified glaciomarine sediments laterally are transitional to glacial drift at about 3 km along the profile (see Fig. 2 for location).

Profil Huntec de sismique réflexion de haute résolution montrant la situation au trou de forage 90- 023-71, à 9 km de l'entrée de la baie de Wakeham, au centre sud du détroit d'Hudson. La transition des sédiments glaciomarins stratifiés (selon les ondes acoustiques) aux dépôts glaciaires se fait à environ 3 km le long du profil (localisation à la fig. 2).

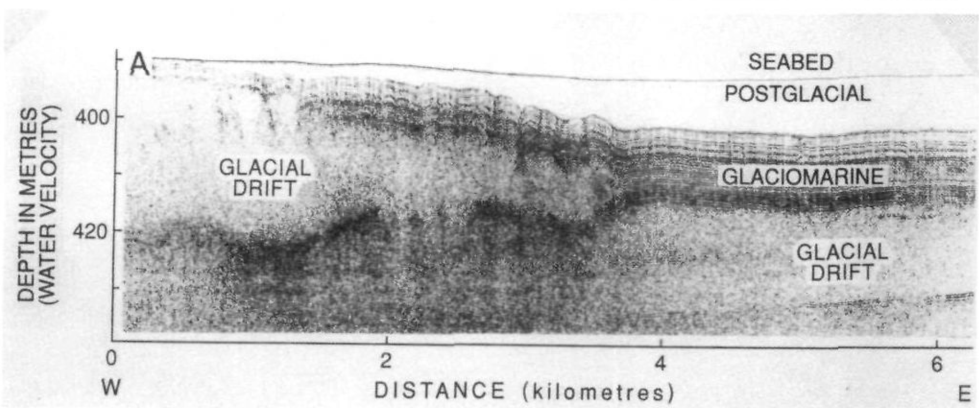


FIGURE 16. Huntec high resolution seismic reflection profile illustrating the transition of glaciomarine sediments cored at station 90-023-85 in southwestern Hudson Strait to glacial drift 11 km west of the core site (location A on Fig. 2).

Profil Huntec de sismique réflexion de haute résolution montrant la transition des sédiments glaciomarins aux dépôts glaciaires à 11 km à l'ouest du site de forage 90-023-85, au sud-ouest du détroit d'Hudson (site A de la fig. 2).

acoustically stratified sediments. These units contained foraminiferal assemblages of Faunal Zones D and B respectively (Fig. 9, Table I), denoting glaciomarine ice distal and postglacial depositional environments (Vilks *et al.*, 1989). An AMS date on a single valve of *Clinocardium ciliatum* from the base of the core within Faunal Zone B yielded an age of 6280 ± 50 (To-293) (Vilks *et al.*,1989) (Table I, Fig. 7).

Core 90-023-85 was collected from sediments in the southwestern basin at a locality 13 km west-northwest of the Core 85-027-65 site (Fig. 2, 5). The Core 90-023-85 site is underlain by two or more sequences of glacial drift (Seismic Units 1 and 2), 7 m of acoustically stratified sediments of Unit 3, and 4 m of acoustically transparent sediments of Units 4 and 5. Eleven kilometres west of the core site and 30 km northeast of Promontoire Colbert (Fig. 1), the sediments of Seismic Unit 3 intertongue with glacial drift (Fig. 16). The drift sequences total at least 80 m in thickness in this region. Studies of foraminiferal assemblages in Core 90-023-85 (Fig. 17) confirm that the acoustically stratified sediments of Seismic Unit 3 contain Faunal Zones A and B indicative of glaciomarine ice proximal and ice distal depositional environments (Table I). The boundary between these zones occurs at 240 cm down core. Postglacial Faunal Zone D assemblages are present in the upper 120 cm of the core. The uppermost 3 m of seafloor sediments apparently were not recovered by the corer. Chronological data are not yet available for this core.

Core 85-027-68 was collected at a locality 45 km north of Charles Island in the main western basin (Figs. 2, 18). Seismic data indicate that sediments in this basin attain thicknesses of 130 m. These comprise basal, acoustically massive, unstratified sediments of Seismic Units 1 and 2 up to 90 m thick, interpreted to be glacial drift, that are overlain by acoustically stratified sediments of Seismic Unit 3 up to 30 m thick, and by acoustically more weakly stratified sediments of Unit 5 that vary in thickness from < 1 m up to possibly 18 m in some areas (MacLean *et al.*, 1986; Vilks *et al.*, 1989). The beds of Unit 3 are transitional to glacial drift at the basin margins (MacLean *et al.*, 1991). Seismic Unit 5 was not reliably divisible from the sediments of Unit 3 at the core site on the seismic reflection data, however, foraminiferal data indicate *ca.* 2.7 m of Unit 5 postglacial sediments are present.

Studies of foraminifera in Core 85-027-68 indicated the presence of Faunal Zone A, B, and D assemblages interpreted by Vilks *et al.* (1989) to be indicative of glaciomarine

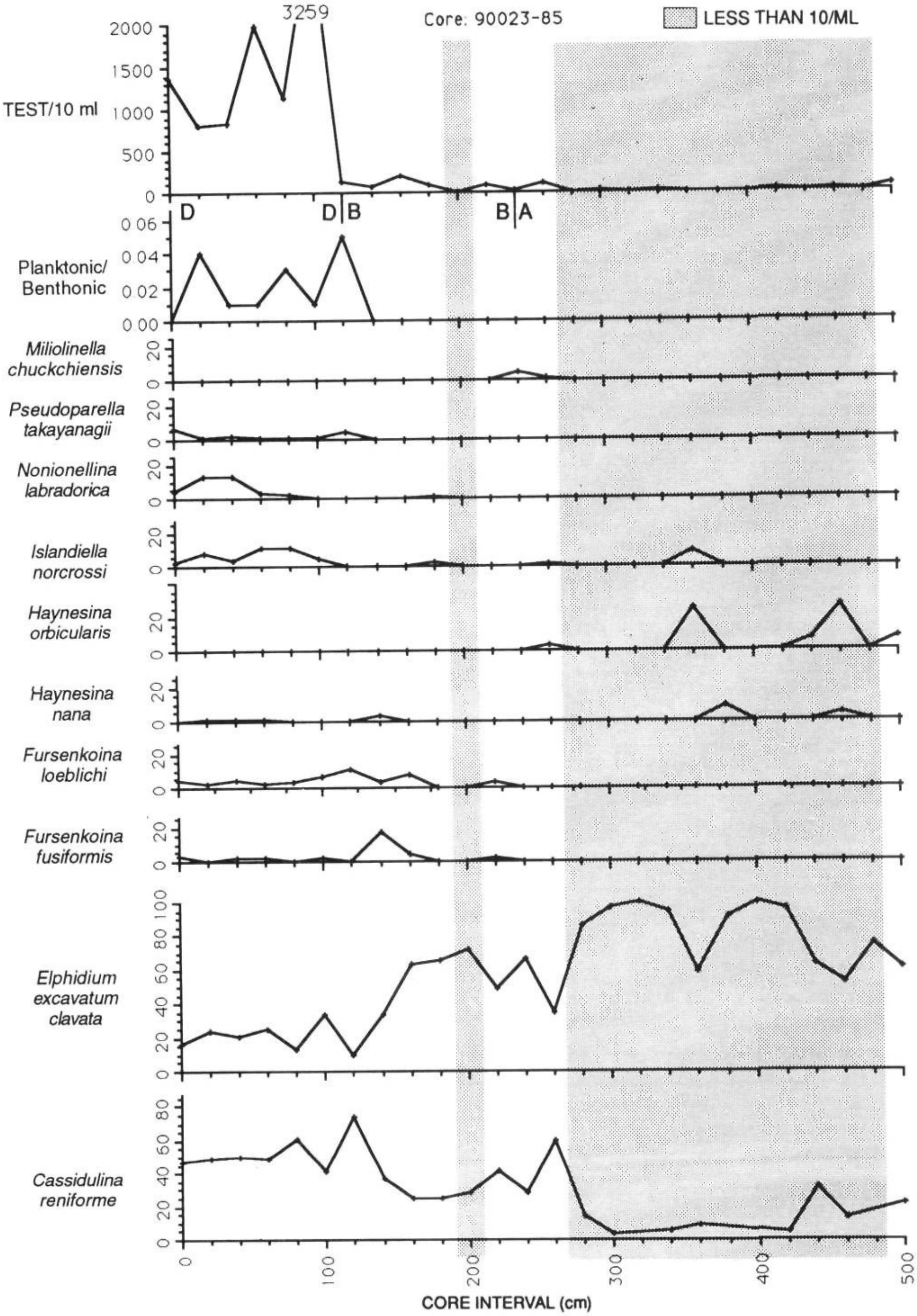


FIGURE 17. Abundances (per cent) of major foraminifera species in Core 90-023-85. Shaded areas contain < 10 foraminifera tests per ml.

Abondance (en %) des principales espèces de foraminifères dans la carotte 90-023-85. Les parties tramées renferment < 10 tests de foraminifères/ml.

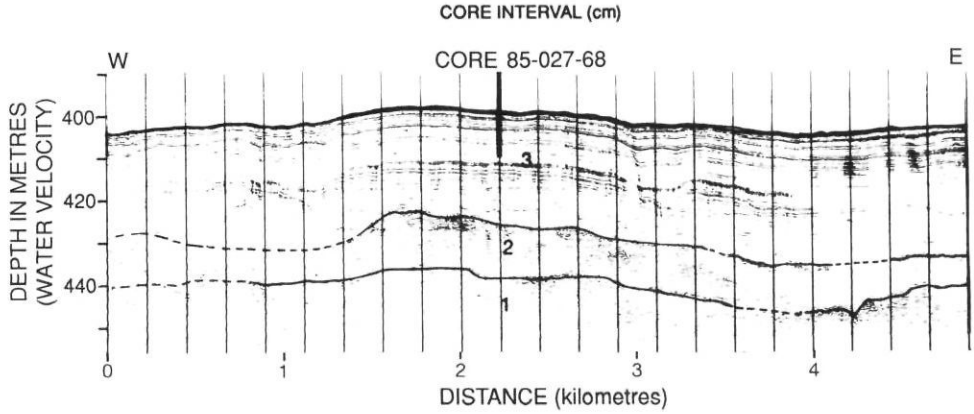
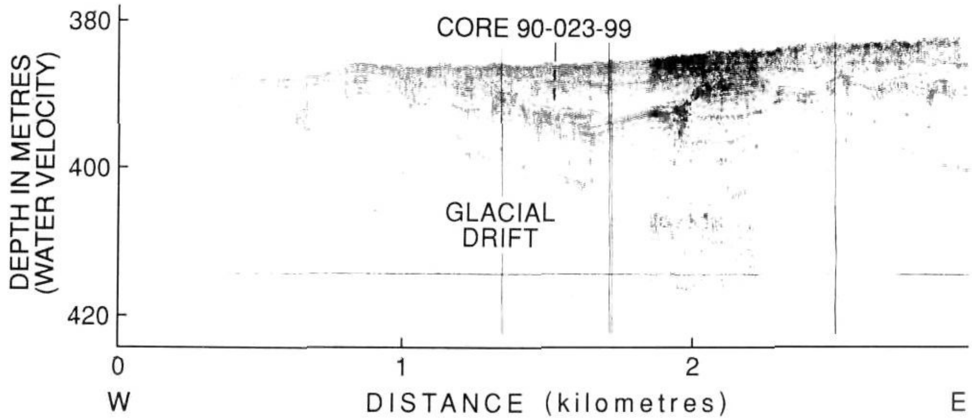


FIGURE 18. Huntec high resolution seismic reflection profile illustrating the setting at the 85-027-68 core locality in the basin north of Charles Island in western Hudson Strait. Two glacial drift units (1 and 2) are overlain by up to 30 m of glaciomarine sediments (Unit 3). Foraminiferal data indicate the presence of 2.7 m of postglacial sediments (Unit 5) which are undifferentiated on the profile (see Fig. 2 for location). (Modified from Vilks *et al.*, 1989.)

Profil Huntec de sismique réflexion de haute résolution montrant la situation au trou de forage 85-027-68 dans le bassin au nord de Charles Island, au sud-ouest du détroit d'Hudson. Deux unités de dépôts glaciaires (1 et 2) sont recouvertes par des sédiments glaciomarins jusqu'à 30 m d'épaisseur (unité 3). Les données sur les foraminifères indiquent la présence de 2,7 m de sédiments postglaciaires (unité 5) qu'on ne peut distinguer sur le profil (à partir de Vilks et al., *1989) (localisation à la fig. 2).*

FIGURE 19. 3.5 kHz profile illustrating the geological setting in the western Hudson Strait basin north of Charles Island from which Core 90-023-99 was recovered (see Fig. 2 for location).

Profil de 3,5 kHz montrant le cadre géologique à l'ouest du détroit d'Hudson au nord de Charles Island, au site de forage 90-023-99.



ice proximal, ice distal, and late postglacial depositional environments respectively (Figs. 7, 9). An AMS date on fragments of *Portlandia arctica* 5.2 m below the top of Zone A, broken during core splitting, yielded an age of 7900 ± 70 BP (To-751) (Vilks *et al.*, 1989) (Table I, Fig. 7).

Core 90-023-99 was also obtained from the western basin, at a locality 13 km west of the Core 85-027-68 site (Figs. 2, 19). Foraminifera in the core indicate the presence of Faunal Zones A, B, and D (Fig. 20). Faunal Zone A assemblages are present in the bottom 2 m, and Zone B assemblages in the overlying 1.9 m: these thicknesses are quite similar to those in Core 85-027-68 (Fig. 7). The boundary between Zone B and D assemblages occurs 0.9 m downcore. An AMS date on mollusc fragments from a depth of 0.5 m below the top of Zone B yielded an age of 8140 ± 160 BP (To-2470) (Table I, Fig. 7).

Ungava Bay

Thick deposits of sediments that are acoustically stratified occur in the marginal channel in the southern part of Ungava Bay. These deposits, commonly 20-40 m thick, and locally up to 80 m, infill and cover a very irregular surface across Precambrian rocks (MacLean *et al.*, 1991). Core 90-023-59 was collected in this sequence (Figs. 2, 21). Foraminiferal assemblages are entirely of Faunal Zone D (Fig. 22) (Table I). This has been interpreted by MacLean and Vilks (1992) to reflect fluvial input from the very large drainage basin emptying into southern Ungava Bay, and probable substantial meltwater as glacial ice decayed and retreated southward. Higher amplitude acoustic reflectors lower in the section on the Huntec high resolution profile (Fig. 21) suggest the presence of glaciomarine sediments at depth.

SUMMARY AND CONCLUSIONS

Data from high resolution and shallow seismic reflection profiles and sediment cores provide regional information on the distribution, depositional environments, and age of late Quaternary sediments in Hudson Strait and Ungava Bay. Greatest sediment thicknesses, up to 130 m, occur in the basin in eastern Hudson Strait north of Ungava Bay and in the basin north of Charles Island in the western part of the Strait.

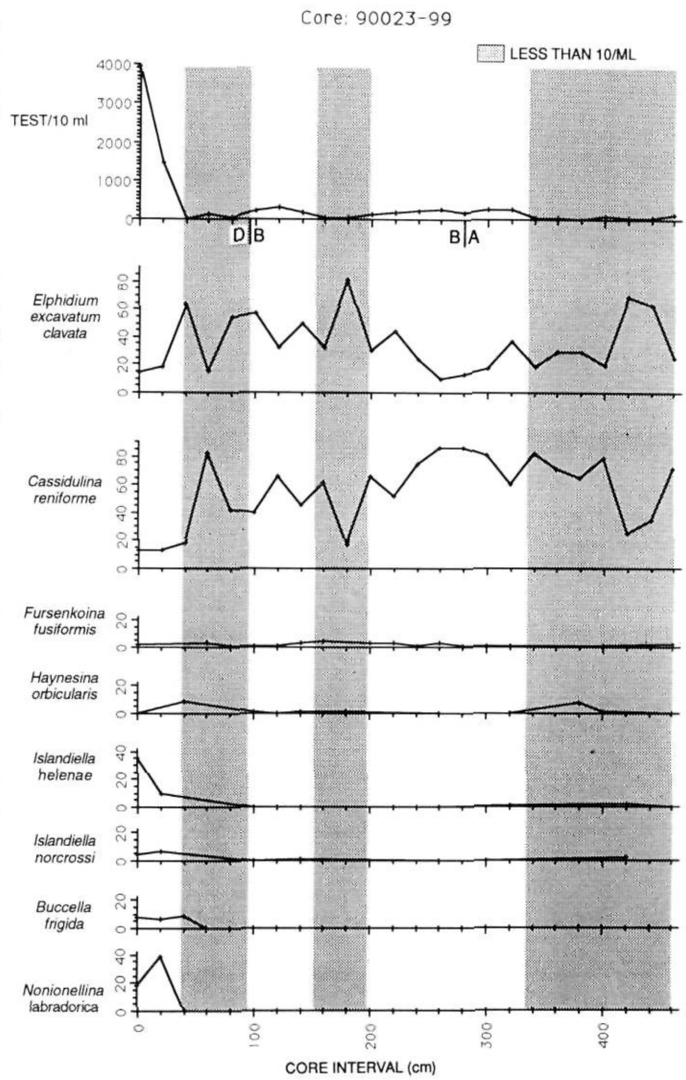


FIGURE 20. Abundances (per cent) of major foraminifera species in Core 90-023-99. Shaded areas contain < 10 foraminifera tests per ml.

Abondance (en %) des principales espèces de foraminifères dans la carotte 90-023-99. Les parties tramées renferment < 10 tests de foraminifères/ml.

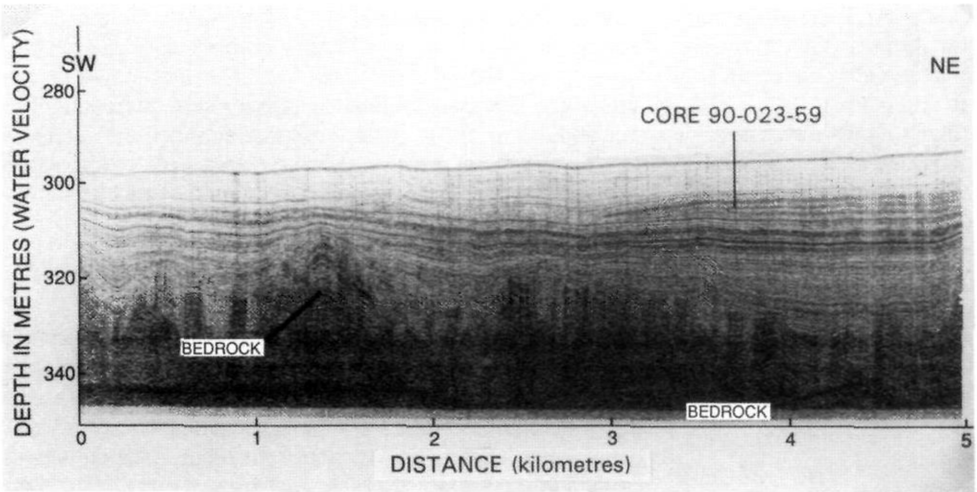


FIGURE 21. Huntec high resolution seismic reflection profile illustrating the thick sequence of sediments underlying the Core 90-023-59 locality in southern Ungava Bay. The section sampled by the corer consisted entirely of postglacial sediments, but glaciomarine sequences may occur lower in the section (see Fig. 2 for location).

Profil Huntec de sismique réflexion de haute résolution montrant l'épaisse séquence de sédiments sous-jacente au site de forage 90-023-59, au sud de la baie d'Ungava. La partie échantillonnée ne comprenait que des sédiments postglaciaires, mais des séquences glaciomarines pourraient se trouver plus en profondeur (localisation à la fig. 2).

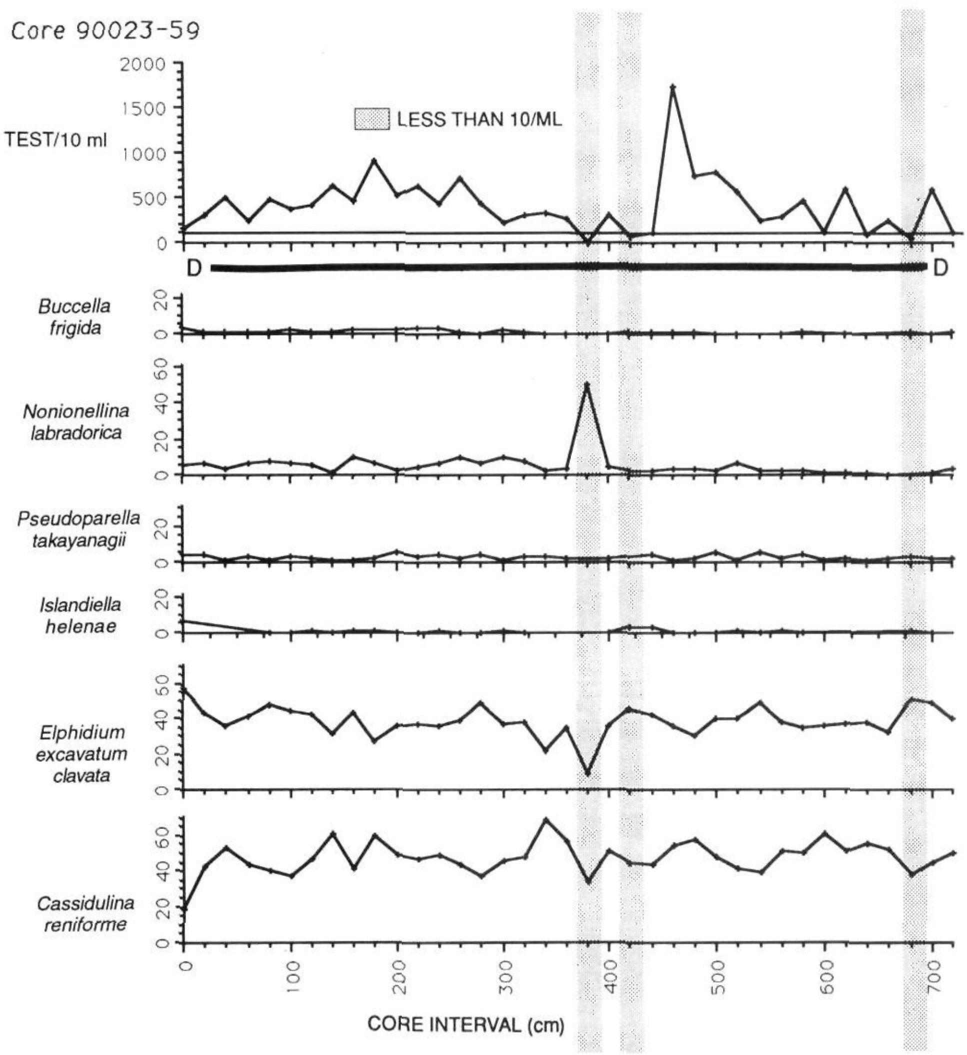


FIGURE 22. Abundances (per cent) of major foraminifera species in Core 90-023-59. Shaded areas contain < 10 foraminifera tests per ml.

Abondance (en %) des principales espèces de foraminifères dans la carotte 90-023-59. Les parties tramées renferment < 10 tests de foraminifères/ml.

Significant sediment deposits also occur in the south central and southwestern parts of the Strait, and in southern Ungava Bay.

Sediments interpreted to be glacial drift deposited in a sub-glacial environment are widely distributed, and in places contain multiple drift sequences and locally form moraines. Thick accumulations of other late Quaternary sediment units also occur. Studies of their contained foraminiferal assemblages indicate that deposition of these sediments occurred in glaciomarine ice proximal and ice distal, and early and late postglacial environments. In contrast to the widespread distribution of the glacial drift, deposits of the glaciomarine and postglacial sediments occur principally in basinal areas comprising: 1) the three main Hudson Strait basins; 2) basins, large embayments, and adjoining fiords along the south side of the Strait; and 3) in the southern part of the marginal channel surrounding the central platform in Ungava Bay. The early postglacial environment to date has only been recognized in the eastern part of the Strait. Lateral transition of glacial drift to glaciomarine sediments is evident on high resolution seismic profiles in many basin margin areas and in the Wakeham Bay-Baie Héricart region of south central Hudson Strait where the late glacial ice margin stood offshore and some late ice readvances of apparently limited extent occurred.

Cores 90-023-66, 71, and 107 (Figs. 10, 11, 15) were collected at sites in close proximity (0.7 to 3 km) to late glacial ice margins in the previously largely uninvestigated central part of the Strait. Core 90-023-85 from a locality in the basin southwest of Charles Island is slightly more distant (11 km). Glaciomarine sediments at each of these localities laterally intertongue with or are transitional to glacial drift. Cores 85-027-55, 56,57,65 and 68 and 90-023-59 and 99 provide information on conditions in the main basins generally farther removed from the late ice margins. Resulting data on depositional environments are indicated by the foraminiferal zones, age dates, and seismic units summarized in Figure 7.

The oldest dates obtained are from shells in three of the cores, all from the south central area of the Strait, 90-023-66, 71, and 107 (Table I, Fig. 7). These range from 8390 ± 70 BP (To-2472) in Core 107, 8440 ± 90 BP (To-2463) in Core 66, to 8520 ± 80 BP (To-2466) in Core 71[2]. The high resolution profile data, however, indicate that these dated intervals are underlain by substantial thicknesses of acoustically stratified sediments (Figs. 10, 11, 15) (Table I). Extrapolatation of sedimentation rates between dated intervals in Cores 66 and 107 to the base of the acoustically stratified sediments suggests that glaciomarine conditions in that region possibly could have been present as early as 10,000-11, 900 BP (MacLean and Vilks, 1992). This would be compatible with evidence from the Deception Bay region in the western part of the Strait where dates as old as 9400 and 9600 BP were obtained from shells in glaciomarine sediments (Gray et al.,1985; Gray and Lauriol, 1985; Bruneau *et al.*,1990; Gray *et al.*, 1992), and possibly as early as 10,700 BP (Kaufman *et al.*, 1992). Together, these suggest at least partial deglaciation of the Strait at that time. This may have been confined to a seaway developed through the deeper water areas along the south side of the Strait, where the ice would tend to first become unstable and to calve earlier and more rapidly. A deglaciation date of about 8300 BP for the Big Island region (Clark, 1985) suggests that glacial ice may have persisted considerably longer on the shallower north side of the Strait.

Acoustic profile and sample data from Cores 90-023-66, 71, and 107 indicate that an ice margin associated with a late glacial readvance stood offshore in the Wakeham Bay-Baie Héricart region *ca.* 8500 BP, or a little earlier. This advance is thought to have been of relatively limited extent, and to have been only lightly bearing on the seabed, as previously deposited glaciomarine sediments, which were overridden, were preserved. Thick glacial ice has not covered the Wakeham Bay-Baie Héricart offshore region subsequent to the deposition of the glaciomarine sequences that underlie the 90-023-66 and 107 localities. Tentatively extrapolated ages for the base of those sections are in the order of 10,100 to 11,900 BP.

2. Footnote added in press: Foraminifera from 90-023-107 interval 497-499 cm yielded on AMS date of 8990 ± 190 (To-3274) (Manley *et al.*, in press).

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